LUIS MATEUS ROCHA

Modeling, Algorithms, and Informatics Group (CCS-3)
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PERSONAL DATA

Luis Rocha is a Technical Staff Member at the *Los Alamos National Laboratory* with the *Modeling, Algorithms, and Informatics Group*), where he is the leader of the *Complex Systems Modeling Research Focus Area*, and is involved in several research projects. He is also a visiting professor at the *Instituto Gulbenkian da Ciencia*, where he is the director of the *Mathematical and Computational Biology Collaboratorium* and is a member of the Computational Biology Steering Committee which oversees the associated *PhD program in Computational Biology*. He habitually reviews articles and proposals in his scientific community. He has published many articles in scientific and technologic journals, and has been the recipient of several scholarships and awards.

RESEARCH INTERESTS

Complex Systems Modeling: Network Analysis (Biological, Social and Knowledge Networks), Agent-based Modeling, Collective Knowledge Organization, Dynamical Systems.

Computational and Mathematical Biology: Bioinformatics, Microarray Data Analysis, Automatic Functional Annotation, RNA Editing, Network Models, Systems Biology, Evolutionary Systems, Origin of Codes.

Distributed Artificial Intelligence and Artificial Life: Adaptive and Evolutionary Computation, Cellular Automata, Emergent Computation, Embodied Cognition, Cognitive Categorization, Origin of Symbols.

Informatics: Intelligent Information Retrieval, Recommendation Systems, Knowledge Management, Data-Mining, Knowledge Discovery, Bioinformatics, Internet Development.

Uncertainty Modeling: Fuzzy Set Theory, Evidence Theory, Measures of Uncertainty, Interval Computation, Evidence Sets, Fuzzy Graphs, Decision-Support Systems.

ACADEMIC EDUCATION

STATE UNIVERSITY OF NEW YORK, BINGHAMTON, NEW YORK
PhD in Systems Science and *Computer Science* (1997)

- Primary Advisors: Prof. George Klir and Prof. Howard Pattee.
- Courses in Systems Science, Artificial Intelligence, Self-Organizing Systems, Complexity Theory, Adaptive Systems, Neural Networks, Genetic Algorithms, Fuzzy sets and Uncertainty, Fuzzy Measures, Dempster-Shafer Theory of Evidence, Evolutionary Systems and Artificial Life, and Cognitive Science.
- Dissertation: "*Evidence Sets and Contextual Genetic Algorithms: Exploring Uncertainty, Context, and Embodiment in Cognitive and Evolutionary Systems*".

INSTITUTO SUPERIOR TÉCNICO, LISBON, PORTUGAL
Licentiate (5 year degree) in Mechanical and Systems Engineering (1985-1990): equivalent to Bachelor's in Mechanical Engineering (1985-1988) and Masters in Systems Engineering (1988-1990)

Including and exchange semester at STAFFORDSHIRE UNIVERSITY, STAFFORD, ENGLAND, attending the *Msc. in Computer Integrated Manufacturing (CIM).*

PROFESSIONAL APPOINTMENTS

LOS ALAMOS NATIONAL LABORATORY, MODELING, ALGORITHMS, AND INFORMATICS GROUP
Postdoctoral Associate, September 1997 to January 1999
Technical Staff Member, Since February 1999

- Leader of the *Complex Systems Team* (1 year) now a Research Focus Area (http://www.c3.lanl.gov/~rocha/complex)
- Leader and member of several research projects for a combined budget of US$ 630,000 for FY 04 (see details in funded projects).
- On-going project development in the areas of *Complex Systems*, *Computational Biology*, and *Distributed Artificial Intelligence and Artificial Life* (see http://www.c3.lanl.gov/~rocha/cprojects.html).
- Work with graduate and undergraduate students. Currently overseeing 4 PhD students and 1 postdoctoral associate.

INSTITUTO GULBENKIAN DA CIENCIA, Lisbon Portugal.
Director of the Mathematical and Computational Biology Collaboratorium and member of the Computational Biology Steering Committee which oversees the PhD in Computational Biology, 04/00-present.

Has also taught a PhD a course in Bioinformatics for the Ph.D program on Biomedicine (http://www.c3.lanl.gov/~rocha/bioinformatics).

UNIVERSITY OF CALIFORNIA, LOS ANGELES, INSTITUTE FOR PURE AND APPLIED MATHEMATICS
Fellowship appointment, March-June 2004

Program on "Proteomics: Sequence, Structure, Function"

STATE UNIVERSITY OF NEW YORK AT BINGHAMTON, DEPARTMENT OF SYSTEMS SCIENCE AND INDUSTRIAL ENGINEERING

- *Adjunct Professor, 1995-1997*. Developed and taught the graduate course *"Evolutionary Systems and Artificial Life"*. Course materials can be found on the World Wide Web at: http://www.c3.lanl.gov/~rocha/alife.html.
- *Research Assistant, April 1996-January 1997*. Model design of budget and fleet readiness requirements for the U.S. NAVY bases. Data analysis with neural networks: Backpropagation and Adaptive Resonance Theory (ART2), NEURALWARE. Simulation of port operations with SIMAN/ARENA.
- *Teaching Assistant, Fall 1995, Spring 1996, and Spring 1997*. Assisted and taught the computational sections of the graduate courses "Neural Network and Genetic Models" and "Modeling and Simulation". Created interactive World Wide Web assignments: http://www.c3.lanl.gov/~rocha/assign.html.
- *Information Systems Manager, 1995*-1997. Established and maintained the department's Internet server.

LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL (NATIONAL LABORATORY FOR CIVIL ENGINEERING), LISBON, PORTUGAL
Research Assistant from June 1990 to December 1990 (part-time)
Graduate Researcher from January 1991 to November 1991 (full-time)

Design and development of the control system for a seismic table used to execute earthquake resistance tests on large scale models of structures. Developed the software for portions of its control system as well as signal identification and analysis in *Fortran* and *C*.

PROFESSIONAL SERVICE

Editorial Board

Journal of Applied Systems Studies

Ad Hoc Editor

Artificial Life, Biosystems, Communication and Cognition - Artificial Intelligence

Ad Hoc Reviewer

Adaptive Behavior, *Advances in Complex Systems*, *Artificial Life*, *Behavioral and Brain Sciences*, *Biosystems*, *Clinical Chemistry*, *Complex Systems*, *IEEE Transactions on Evolutionary Computation*, *IEEE Transaction on Systems Man and Cybernetics*, *International Journal of Human-Computer Studies*, *International Journal of General Systems*, *International Journal of Operations Research*, *Journal of Artificial Societies and Social Simulation*, *Proceedings of the National Academy of Sciences* (PNAS), *Systems Research.*

Conference Program Committees

2004 Congress on Evolutionary Computation (CEC), Portland, Oregon, June 19-23

Agent-Based Simulation 5, Lisbon, Portugal May 3-5, 2004

Genetic Regulatory Networks: Theory and Practice (workshop) Canberra, Australia, December 2003

2003 Congress on Evolutionary Computation (CEC), Canberra, Australia, December 2003

IEEE Integration of Knowledge Intensive Multi-Agent Systems, Cambridge, MA., 1-3 October 2003.

Oeiras Mathematical and Computational Biology Workshop, Oeiras, Portugal, June 20th 2003.

Autonomy, Delegation, and Control: From Inter-agent to Organizations and Institutions Workshop, 2nd *International Conference on Autonomous Agents and Multi-Agent Systems*, Melbourne, Australia, July 14-18, 2003

11th Portuguese Conference on Artificial Intelligence - EPIA'03, December 4-7, 2003, Beja, Portugal.

International interdisciplinary seminar on new robotics, evolution and embodied cognition, Lisbon, Portugal, November 12-15 2002

Workshop on Distributed Computing Architectures for Digital Libraries, at the 31th *International Conference on Parallel Processing* ICPP 2002, Vancouver, Canada August 18-21, 2002.

Congress on Evolutionary Computation (CEC) part of the IEEE World Congress on Computational Intelligence, Hawaii, 2002

10th Mediterranean Conference On Control And Automation Med2002, Lisbon, Portugal July 2002

From Intelligent Networks to the Global Brain: Evolutionary Social Organization through Knowledge Technology, Brussels, July 3-5, 2001.

Complex Systems 2000, Dunedin, New Zealand, November 2000.

1998 Conference on Intelligent Systems and Semiotics, NIST, Gaithersburg, Maryland – Session Chair.

2nd International Symposium On Intelligent Manufacturing Systems, August 1998, Sakarya , Turkey

Review Panels

UMCEES Review Panel, National Research Council, 2001

Information Technology and Robotics Review Panel of the Fundacao Ciencia e Tecnologia, Portugal, 2000, 2003

Computer Science and Software Engineering internal proposal (LDRD) review committee at the Los Alamos National Laboratory 1998-2000.

INVITED TALKS AND CONFERENCE APPEARANCES

UNIVERSITY OF INDIANA, BLOOMINGTON, SCHOOL OF INFORMATICS AND COGNITIVE SCIENCE PROGRAM, February 16th, 2004

Invited Speaker

GENETIC REGULATORY NETWORKS: THEORY AND PRACTICE, Canberra, Australia, 8th - 12th December 2003

Co-Chair: http://www.itee.uq.edu.au/~complexity/CEC_Special_Session/

OEIRAS MATHEMATICAL AND COMPUTATIONAL BIOLOGY WORKSHOP, Oeiras, Portugal, June 20th 2003.

Co-Chair: http://www.c3.lanl.gov/~rocha/cbigc

INFORMATION SCIENCE AND TECHNOLOGY COLLOQUIUM, NASA GODDARD SPACE FLIGHT CENTER, Jan. 29, 2003

Featured speaker

CENTER FOR THE STUDY OF COMPLEX SYSTEMS, UNIVERSITY OF MICHIGAN, ANN ARBOR, December 5, 2002

Invited Speaker

ENTREPRENEURSHIP IN BIOTECHNOLOGY, VENTURING IDEAS ACROSS THE ATLANTIC WORKSHOP, Newark, NJ, January 31, 2003

Invited Speaker

INTERNATIONAL INTERDISCIPLINARY SEMINAR ON NEW ROBOTICS, EVOLUTION AND EMBODIED COGNITION, LISBON, PORTUGAL, NOVEMBER 12-15 2002.
Co-Chair and Invited Speaker: http://wwwc3.lanl.gov/~rocha/embrob
2002 INNOVATIVE STUDIES RESEARCH PROGRAM WORKSHOP, Santa Fe, NM October 15th
invited speaker
WORKSHOP ON ENABLING CONCEPTS IN BIOSYSTEMS ANALYSIS, SEPTEMBER 19-20, 2002, SANTA FE, NM
Invited Speaker
CRITICAL STUDIES WORKSHOP, STANFORD UNIVERSITY, MAY 8, 2002.
Invited speaker.
WORKSHOP OF THE SYSTEMS THEORY OF BIO-INFORMATICS AND ITS EXTENSION TOWARDS ENGINEERING DESIGN THEORY PROJECT, GRADUATE SCHOOL OF ENGINEERING, KYOTO UNIVERSITY, KYOTO, JAPAN, NOVEMBER 2001.
Invited Speaker
1ST PORTUGUESE MEETING ON THEORETICAL AND COMPUTATIONAL BIOLOGY. INSTITUTO GULBENKIAN DE CIENCIA, OEIRAS, PORTUGAL, 23RD-26TH OF OCTOBER 2001
Invited Speaker
NATO ADVANCED RESEARCH WORKSHOP ON SYSTEMATIC ORGANISATION OF INFORMATION USING FUZZY SYSTEMS, VILA REAL, PORTUGAL, 24TH-26TH OF OCTOBER 2001
Invited Speaker
FROM INTELLIGENT NETWORKS TO THE GLOBAL BRAIN: EVOLUTIONARY SOCIAL ORGANIZATION THROUGH KNOWLEDGE TECHNOLOGY, BRUSSELS, JULY 3-5, 2001.
Invited Speaker
III ENCONTRO DO FORUM INTERNACIONAL DE INVESTIGADORES PORTUGUESES, FARO, PORTUGAL APRIL 7-10, 2001.
Invited Speaker in Computer Science Session
INSTITUTO GULBENKIAN DA CIENCIA, LISBON PORTUGAL, MARCH 2001.
Invited Speaker
GORDON RESEARCH CONFERENCE ON RNA EDITING, JANUARY 21-26, 2001, VENTURA, CA.
Keynote Session Speaker.
HETERARCHIES: DISTRIBUTED INTELLIGENCE AND THE ORGANIZATION OF DIVERSITY, SANTA FE INSTITUTE WORKSHOP OCTOBER 13 AND 14, 2000, SANTA FE, NM.
Invited Speaker
INSTITUTO DE SISTEMAS E ROBOTICA, INSTITUTO SUPERIOR TECNICO, LISBON, PORTUGAL. AUGUST 2000 AND SEPTEMBER 2001.
Invited Speaker
XEROX PARC, PALO ALTO. JUNE 2000
Invited Speaker at the User-Interaction Group
DESIGN PRINCIPLES FOR THE IMMUNE SYSTEM AND OTHER DISTRIBUTED AUTONOMOUS SYSTEMS, SANTA FE INSTITUTE, JULY 1999, SANTA FE, NEW MEXICO.
Invited Speaker
INTERNATIONAL MEETING ON EMERGENT ORGANIZATIONS AND THEIR DYNAMICS, MAY 1999, UNIVERSITY OF GHENT, GHENT, BELGIUM
Invited Speaker
ISIC/CIRA/ISAS '98: IEEE INTERNATIONAL SYMPOSIUM ON INTELLIGENT CONTROL (ISIC), INTERNATIONAL SYMPOSIUM ON COMPUTATIONAL INTELLIGENCE IN ROBOTICS AND AUTOMATION (CIRA), INTELLIGENT SYSTEMS AND SEMIOTICS (ISAS), SEPTEMBER 1998, GAITHERSBURG, MARYLAND U.S.A.
Co-Chair of the "Semiotics of Autonomous Information Systems" session, member of the Program Committee
WORKSHOP ON EMERGENT SEMANTIC AND COMPUTATIONAL PROCESSES IN DISTRIBUTED INFORMATION SYSTEMS, AUGUST 1998, LOS ALAMOS, NEW MEXICO
Co-organizer (http://www.c3.lanl.gov/~joslyn/pcp/workshop98.html)
2ND INTERNATIONAL SYMPOSIUM ON INTELLIGENT MANUFACTURING SYSTEMS, AUGUST 1998, SAKARYA , TURKEY
Chair of the "Emergent Computation and Intelligent Manufacturing Systems" session, and member of the Program Committee
THE PHILOSOPHY OF ARTIFICIAL LIFE, MARCH 1997. CHRIST CHURCH, OXFORD, UNITED KINGDOM
Invited Participant

WORKSHOP ON CONTROL MECHANISMS FOR COMPLEX SYSTEMS, DECEMBER 1996, U.S. AIR FORCE BASE, LAS CRUCES, NEW MEXICO, U.S.A.
Invited Speaker

THE LOS ALAMOS NATIONAL LABORATORY, (CNLS/XCM), AUGUST 1996, LOS ALAMOS, NEW MEXICO, U.S.A.
Invited Speaker

THE SANTA FE INSTITUTE, AUGUST 1996, SANTA FE, NEW MEXICO, U.S.A.
Invited Speaker

WASHIGNTON EVOLUTIONARY SYSTEMS SOCIETY, SEPTEMBER 21, 1995 WASHINGTON D.C., U.S.A.
Invited Speaker

INTERNATIONAL MEETING ON EVOLVING SYSTEMS, MARCH 1995, KONRAD LORENZ INSTITUTE, VIENNA, AUSTRIA
Invited Speaker

JOINT CONFERENCE OF THE NORTH AMERICAN FUZZY INFORMATION PROCESSING SOCIETY (NAFIPS), INTERNATIONAL FEDERATION OF INFORMATION SYSTEMS (IFIS), AND NORTH AMERICAN SPACE AGENCY (NASA): NAFIPS/IFIS/NASA'94, DECEMBER 1994, SAN ANTONIO, TEXAS, U.S.A.
Session Chair

ARTIFICIAL LIFE: A BRIDGE TOWARDS A NEW ARTIFICIAL INTELLIGENCE, DECEMBER 1993, SAN SEBASTIAN, SPAIN
Invited participant

SUCCESSFUL GRANTS AND FUNDED PROJECTS

DEPARTMENT OF ENERGY/LOS ALAMOS NATIONAL LABORATORY, LDRD-DR, 2002-2005
Structural Bioinformatics: Inferring protein function from sequence and structure on a genomic scale
Funded to investigate literature mining techniques, as part of this larger project, to discover protein functions associated with known protein structures. Responsible for a budget of 103K$

LOS ALAMOS NATIONAL LABORATORY, RESEARCH LIBRARY, 1998-2004
Research and Development of Active Recommendations Systems for the Library Without Walls Project.
Funded to develop the next generation of recommendation systems for distributed information systems. Budget FY03 300K$. (http://arp.lanl.gov).

DEPARTMENT OF ENERGY/LOS ALAMOS NATIONAL LABORATORY - LDRD-ER, 2001-2004
Identification of Interests, Trends and Dynamics in Document Networks.
Funded to investigate the metric behavior of distance functions on document graphs as a predictor and identifier of semantic relationships. Budget FY03 105K$ (http://wwwc3.lanl.gov/~rocha/DN/)

DEPARTMENT OF ENERGY/LOS ALAMOS NATIONAL LABORATORY - LDRD- DR, 2002
Discovering Signatures of Human Infection by Biothreat Agents with Application to Bioterrorism Countermeasures– Literature Analysis Component
Funded to produce text mining techniques to discover novel relationships among components of the immune system. Budget FY02 20K$

DEPARTMENT OF ENERGY/LOS ALAMOS NATIONAL LABORATORY - LDRD- DR, 2002
Advanced Knowledge Integration In Assessing Terrorist Threats – Network Analysis Component
Network analysis methods to discover implicit relationships in databases of documents. Budget FY02 50K$

DEPARTMENT OF ENERGY/LOS ALAMOS NATIONAL LABORATORY, 1998-2001
Gene Expression Array Analysis as Part of the Functional Genomics Research Program
Funded to investigate data-mining techniques to discover hidden relationships in gene expression data. Project leader of a sub-team of 3 researchers. (http://www.c3.lanl.gov/~rocha/fungen)

XEROX CORPORATION/DEPARTMENT OF ENERGY/LOS ALAMOS NATIONAL LABORATORY, 2000-2001
Knowledge Management

Funded to investigate adaptive recommendation systems for distributed information systems. Part of a team of 8 researchers. (http://www.c3.lanl.gov/~josyln/xerox)

PHYSICAL SCIENCE LABORATORY AT NEW MEXICO STATE UNIVERSITY (NMSU), 1998-2000
Agent-based modeling of socio-technical organizations

Funded as the Los Alamos National Laboratory component (2 research staff members) of a multi-institution project. Actively participated in project proposal and statement of work writing. (http://www.c3.lanl.gov/~joslyn/nmsu).

U.S. NAVY (CINCLANFLT) AND RESEARCH FOUNDATION OF THE STATE UNIVERISTY OF NEW YORK AT BINGHAMTON, 1996-1997
Model design of budget and fleet readiness requirements and Simulation of Port Operations

Research Assistant in a project of seven researchers. Actively participated in project proposal writing. Project leader Prof. Donald Gause.

NATO INTERNATIONAL SCIENTIFIC EXCHANGE PROGRAMMES, ENGLAND-THE NETHERLANDS- PORTUGAL, 1990-1992
Research Assistant, Investigation of Inference Mechanisms in Artificial Intelligence

Developed fuzzy logic and approximate reasoning mathematical structures and algorithms. Results published in Rocha [1991], Medina-Martins and Rocha [1992], and Medina-Martins et al [1993, 1994] (see list of publications). Project Directors: Prof. Gordon Pask Prof. Gerard and de Zeeuw in the University of Amsterdam, The Netherlands, and Prof. Pedro Medina-Martins at I.S.T. Portugal.

SCHOLARSHIPS, AWARDS, AND MEDIA COVERAGE

UNIVERSITY OF CALIFORNIA, LOS ANGELES, INSTITUTE FOR PURE AND APPLIED MATHEMATICS
Fellowship, March-June 2004, Program on "Proteomics: Sequence, Structure, Function"

NEWSPAPER ARTICLE "Web May Hold the Key to Achieving Artificial Intelligence" in *The Washington Post*, September 6, 2002; Page A01. http://www.washingtonpost.com/wp-dyn/articles/A43363-2002Sep5.html. Also appeared at MSNBC: http://www.msnbc.com/news/804291.asp?0dm=C13KT.

TELEVISION INTERVIEW in *2010*, *Radiotelevisão Portuguesa* (RTP2) concerning new approaches to Artificial Intelligence and Robotics, November 2002. Http://www.c3.lanl.gov/~rocha/videos/2010rtp_high.rm

NEWSPAPER ARTICLE "Insetos, neurônios e sistema imunológico. Esses são os modelos das redes do futuro" in *Estado de São Paulo*, Brazil, September 16, 2002. http://www.estado.estadao.com.br/suplementos/info/2002/09/16/info041.html. As well as two other pieces including the translation of the Washington Post Article above.

NEWSPAPER ARTICLE "O Português de Los Alamos" in *Expresso* Newspaper, Portugal, August 31, 2002. http://semanal.expresso.pt/economia/artigos/interior.asp?edicao=1557&id_artigo=ES69166

NEWSPAPER ARTICLE "Nova robótica apresenta-se em Lisboa" in *Expresso* Newspaper, Portugal, August 17, 2002. http://semanal.expresso.pt/economia/artigos/interior.asp?edicao=1555&id_artigo=ES68023

MAGAZINE ARTICLE: Informar Portugal - ICEP, Ano II, N. 7, Setembro 2002, page 13.

MCDONNELL-PEW CENTRE FOR COGNITIVE NEUROSCIENCE GRADUATE STUDENT BURSARY to attend the conference *THE PHILOSOPHY OF ARTIFICIAL LIFE* at CHRIST CHURCH, OXFORD, MARCH 1997

BEST PAPER AWARD OF THE *PROGRAMME COMMITTEE OF THE THIRTEENTH EUROPEAN MEETING ON CYBERNETICS AND SYSTEMS RESEARCH*, FOR THE ENTIRE MEETING, AND THE GORDON PASK MEMORIAL AWARD, VIENNA, APRIL 1996
to the contribution "Language Theory: Consensual Selection of Dynamics", Henry, Charles and Luis Rocha [1996]

PRAXIS XXI PROGRAM, JUNTA NACIONAL DE INVESTIGAÇÃO CIENTÍFICA E TECNOLÓGICA, PORTUGAL-EUROPEAN UNION-USA, 1995-1996
PhD Scholarship, Fuzzy Logic and Adaptive Systems
The PRAXIS XXI program is jointly funded by the Portuguese Government and the European Union for continuing doctorate research.

BEST PAPER AWARD OF THE *PROGRAMME COMMITTEE OF THE TWELFTH EUROPEAN MEETING ON CYBERNETICS AND SYSTEMS RESEARCH*, FON THE SYMPOSIUM "HUMANITY, ARCHITECTURE AND CONCEPTUALIZATION" , VIENNA, APRIL 1994
to the contribution "Von Foerster's Cognitive Tiles: Semantically Closed Building Blocks for AI and Alife", Rocha, Luis [1994a]

CIENCIA PROGRAM, JUNTA NACIONAL DE INVESTIGÇÃO CIENTÍFICA E TECNOLÓGICA, PORTUGAL-EUROPEAN UNION-USA, 1992-1995
PhD Scholarship, Fuzzy Logic and Adaptive Systems
The CIENCIA program is jointly funded by the Portuguese Government and the European Union.

ERASMUS PROGRAM SCHOLARSHIP, EUROPEAN UNION, 1990
Exchange Student in the Masters Program of the Staffordshire University, Stafford, England. Computer Integrated Manufacturing.
The ERASMUS project is a European Union program designed for exchange of students between the universities of member countries.

PUBLICATIONS

LONG PUBLICATIONS:

Almeida e Costa, F., Luis M. Rocha ,and M. Bedau (Eds.) [2004]. *Evolutionary Systems, Embodiment and New Robotics*. *Artificial Life*. In Press.

Rocha, Luis M. (Ed.) [1995]. *Self-Reference in Biological and Cognitive Systems*. *Communication and Cognition - Artificial Intelligence.* Vol. 12, nos. 1-2.

Rocha, Luis M. [1997a]. *Evidence Sets and Contextual Genetic Algorithms: Exploring Uncertainty, Context, and Embodiment in Cognitive and Biological Systems.* PhD Dissertation. State University of New York at Binghamton.

Rocha, Luis M. (Ed.)[2001]. *The Physics and Evolution of Symbols and Codes*. *Biosystems* Vol. 60, No. 1-3. Editorial: *Biosystems* Vol. 60, pp. 1-4.

JOURNAL PAPERS:

Challacombe, J,, A. Rechtsteiner, G. Gottardo, L.M. Rocha, E.P. Brown, T. Shenk, M. Altherr, T. Brettin [2004]. "Evaluation of the host transcriptional response to human cytomegalovirus infection". *Physiological Genomics*. Submitted.

Henry, Charles and Luis M. Rocha [1996] "Language Theory: Consensual Selection of Dynamics". *Cybernetics and Systems*. Vol. 27, pp. 541-553.

Joslyn, Cliff and Luis M. Rocha [1998] "Towards a Formal Taxonomy of Hybrid Uncertainty Representations". *Information Sciences*. Vol. 110, pp. 255-277.

Rocha, Luis M. and Cliff Joslyn [1998] "Simulations of Embodied Evolving Semiosis: Emergent Semantics in Artificial Environments".*Simulation Series*; Vol. 30, (2), p.233-238.

Rocha, Luis M. [1995]. "Artificial semantically closed objects." *Communication and Cognition - Artificial Intelligence.* Vol. 12, nos. 1-2 (Rocha [1995a]), pp. 63-90.

Rocha, Luis M. [1996]. "Eigenbehavior and symbols." *Systems Research* Vol. 13, No 3, pp. 371-384.

Rocha, Luis M. [1997]. "Relative Uncertainty and Evidence Sets: A Constructivist Framework." *International Journal of General Systems*. Vol. 26 (1-2), pp. 35-61.

Rocha, Luis M. [1998]."Where is the progress?" *Cybernetics and Human Knowing*. Vol.5, No. 4, pp. 86-90.

Rocha, Luis M. [1999]."Evidence Sets: Modeling Subjective Categories." *International Journal of General Systems*. Vol. 27, pp. 457-494.

Rocha, Luis M. [2000]. "Syntactic autonomy, cellular automata, and RNA editing: or why self-organization needs symbols to evolve and how it might evolve them". In: *Closure: Emergent Organizations and Their Dynamics*. Chandler J.L.R. and G, Van de Vijver (Eds.) *Annals of the N. Y. Academy of Sciences*. Vol. 901, pp 207-223.

Rocha, Luis M. [2001]. "Evolution with material symbol systems". *Biosystems*. Vol. 60, pp. 95-121.

Rocha, Luis M. [2001]. "Adaptive recommendation and open-ended semiosis". *Kybernetes*. Vol. 30, No. 5/6, pp. 821-851.

Rocha, Luis M. And W. Hordijk [2004]. "Material Representations: From the Genetic Code to the Evolution of Cellular Automata". *Artificial Life*. In Press.

BOOK CHAPTERS:

Rocha, Luis M., V. Kreinovich, and R. Kearfott [1996]."Computing Uncertainty in Interval Based Sets." In: *Applications of Interval Computation*. R.B. Kearfott and V. Kreinovich (Eds.). Kluwer Academic Publishers. pp.337-380.

Rocha, Luis M. [1995]."Contextual Genetic Algorithms: Evolving Developmental Rules." In: *Advances in Artificial Life*. F. Moran, A. Moreno, J.J. Merelo, and P. Chacon (Eds.). Lecture Notes in Artificial Intelligence, Springer-Verlag. pp. 368-382.

Rocha, Luis M. [1998]."Selected Self-Organization and the Semiotics of Evolutionary Systems." In: *Evolutionary Systems: Biological and Epistemological Perspectives on Selection and Self-Organization*. S. Salthe, G. Van de Vijver, and M. Delpos (eds.). Kluwer Academic Publishers, pp. 341-358.

Rocha, Luis M. and Johan Bollen [2001]. Biologically motivated distributed designs for adaptive knowledge management". In: *Design Principles for the Immune System and other Distributed Autonomous Systems*. L. Segel and I. Cohen (Eds.) Santa Fe Institute Series in the Sciences of Complexity. Oxford University Press, pp. 305-334.

Rocha, Luis M. [2001]. "TalkMine: a Soft Computing Approach to Adaptive Knowledge Recommendation". In: *Soft Computing Agents: New Trends for Designing Autonomous Systems*. Vincenzo Loia and Salvatore Sessa (Eds.). Physica-Verlag, Springer, pp. 89-116.

Rocha, Luis M. [2002]. "Semi-metric Behavior in Document Networks and its Application to Recommendation Systems". In: *Soft Computing Agents: A New Perspective for Dynamic Information Systems*. V. Loia (Ed.) International Series Frontiers in Artificial Intelligence and Applications. IOS Press, pp. 137-163.

Rocha, L.M. [2003]. "Automatic Conversation Driven by Uncertainty Reduction and Combination of Evidence for Recommendation Agents ". In: *Systematic Organization of Information in Fuzzy Systems*. NATO Science Series. P. Melo-Pinto, H.N. Teodorescu and T. Fukuda (Eds.) IOS Press, pp 249-265.

Wall, Michael E., Andreas Rechtesteiner, and Luis M. Rocha [2003]. "Singular Value Decomposition and Principal Component Analysis ". In: *Understanding And Using Microarray Analysis Techniques: A Practical Guide*. D. P. Berrar, W. Dubitzky, and M. Granzow (Eds.). Kluwer Academic Publishers, pp. 91-109.

CONFERENCE PROCEEDINGS

Bollen, Johan, Hebert Van de Sompel, and Luis M. Rocha [1999]. "Mining associative relations from website logs and their application to context-dependent retrieval using spreading activation". *Workshop on Organizing Web Space* (WOWS), *ACM Digital Libraries 99*, August 1999, Berkeley, California.

Bollen, Johan, Luis M. Rocha [2000]."An Adaptive Systems Approach to the Implementation and Evaluation of Digital Library Recommendation Systems." In: *Research and Advanced Technology for Digital Libraries: 4th European Conference, ECDL 2000.* Lectures Notes in Computer Science, Springer-Verlag, pp.356-359.

Huang, Chien-Feng and Luis M. Rocha [2003]. “Exploration of RNA Editing and Design of Robust Genetic Algorithms”. *2003 IEEE Congress on Evolutionary Computation (CEC)*, Canberra, Australia, December 2003. R.Sarker et al (Eds). IEEE Press, pp. 2799-2806.

Huang, Chien-Feng and Luis M. Rocha [2004]. “A Systematic Study of Genetic Algorithms with Genotype Editing”. *Genetic and Evolutionary Computation Conference (GECCO) 2004.* Submitted

Johnson, Norman, Steen Rasmussen, Cliff Joslyn, Luis Rocha, Steven Smith, and Marianna Kantor [1998] " Symbiotic intelligence: self-organizing knowledge on distributed networks, driven by human interaction". *Proceedings of the Sixth International Conference on Artificial Life*, C. Adami, R. K. Belew, H. Kitano, C. E. Taylor (Eds.), MIT Press, pp. 403-407.

Joslyn, Cliff and L. M. Rocha [2000]. “Towards Semiotic Agent-Based Models of Socio-Technical Organizations.” *Proc. AI, Simulation and Planning in High Autonomy Systems*, ed. HS Sarjoughian et al., pp. 70-79.

Medina-Martins, Pedro R. and Luis M. Rocha [1992]."The in and the out: an evolutionary approach." In: *Cybernetics and Systems '92*. Robert Trappl. World Scientific Press. pp 681-689.

Medina-Martins, Pedro R., Luis M. Rocha, et al [1994]."Metalogues: an essay on computers' psychology — from childhood to adulthood." In: *Cybernetics and Systems 94*. R, Trappl (Ed.). World Scientific Press. pp. 565-572.

Rechtsteiner, A., R. Gottardo, L.M. Rocha, and M.E. Wall[2003]. "Singular Value Decomposition for Analysis of Gene Expression”. *Currents in Computational Molecular Biology*. Proceedings of the *The Seventh Annual International Conference on Research in Computational Molecular Biology* (RECOMB 2003), Berlin, April 10-13, 2003. R. Spang, P.Beziat and M. Vingron (Eds).pp. 275-276

Rechtsteiner, A. and L.M. Rocha [2004]. "MeSH Key Terms for Validation and Annotation of Gene Expression Clusters”. *Conference on Research in Computational Molecular Biology* (RECOMB 2004), San Diego, CA, March 2004. In Press.

Rocha, Luis M. [1991]."Fuzzification of Conversation Theory." In: *Principia Cybernetica Conference*, Free University of Brussels, Brussels, June 1991. Ed. Francis Heylighen.

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Rocha, Luis M. [1998]. “Syntactic autonomy”. In: *Proceedings of the Joint Conference on the Science and Technology of Intelligent Systems (ISIC/CIRA/ISAS 98).* National Institute of Standards and Technology, Gaithersburg, MD, September 1998. IEEE Press, pp. 706-711.

Rocha, Luis M. [1999]. “TalkMine and the Adaptive Recommendation Project”. In: *the Proceedings of the Association for Computing Machinery (ACM) - Digital Libraries 99. U.C. Berkely, August 1999*, pp. 242-243.

Rocha, Luis M. [2001]. "Adaptive Webs for Heterarchies with Diverse Communities of Users". Paper prepared for the workshop *From Intelligent Networks to the Global Brain: Evolutionary Social Organization through Knowledge Technology*, Brussels, July 3-5, 2001.

Rocha, Luis M. [2002]. "Combination of Evidence in Recommendation Systems Characterized by Distance Functions". In: *Proceedings of the 2002 World Congress on Computational Intelligence: FUZZ-IEEE’02.* Honolulu, Hawaii, May 2002. IEEE Press, pp. 203-208.

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Rocha, L. M. and Huang, C.-F. [2004]. “The Role of RNA Editing in Dynamic Environments”. *Ninth International Conference on the Simulation and Synthesis of Living Systems (ALIFE9).* Submitted.

Verspoor, K., T. Simas, C. Joslyn, A. Rechtsteiner, S. Mniszewski, J. Cohn, L.M. Rocha, and A. Fulmer [2004]. "Protein Annotation as Term Categorization in the Gene Ontology". To appear in the *Proceedings of the BioCreative Workshop*.

SHORT PIECES:

Rechtsteiner, A., R. Gottardo, L.M. Rocha, M.E. Wall and T. Brettin [2003]. "Three Algorithms for Filtering and Analysis of Gene Expression Data". Poster at *Pacific Symposium on Biocomputing 2003*.
Rocha, Luis M. [1997]. "Obituary for Professor Gordon Pask". *International Journal of General Systems*. Vol. 26, no. 3, pp. 219-222.
Rocha, Luis M. [1999]. "Complex Systems Modeling: Using Metaphors From Nature in Simulation and Scientific Models". *BITS: Computer and Communications News*. Computing, Information, and Communications Division. Los Alamos National Laboratory. November 1999.
Rocha, Luis M. [2002]. "Partnership of Fools." *Wired Magazine*, (Rants and Raves) April 2002.
Rocha, Luis M. [2002]. "Path to Enlightenment?". *New York Times Book Review*, pp. 4, June 23.
Rocha Luis M. [2003]. "Extraction and Semi-metric Analysis of Social and Biological Networks". Poster at *Networks: Structure, Dynamics and Function*, May 12 - 16, 2003, Santa Fe, New Mexico, USA.
Rocha, Luis M. and Andreas Rechtsteiner [2003]. "Fast Cheap and Synthetic Oracle (FACSO): Proximity Measures to capture Expert Knowledge in the Bibliome". Poster at *Pacific Symposium on Biocomputing 2003*.

ELECTRONIC PUBLICATIONS:
Evolutionary Systems and Artificial Life. Lecture notes for the course taught at the Department of Systems Science and Industrial Engineering at the State University of New York at Binghamton http://www.c3.lanl.gov/~rocha/alife.html
From Artificial Life to Semiotic Agent Models: Review and Research Directions. Los Alamos National Laboratory Internal Report. LA-UR-99-5475. http://www.c3.lanl.gov/~rocha/sim/review.html
Introduction to Bioinformatics. Lecture notes for PhD course at the Instituto Gulbenkian da Ciencia, Oeiras, Portugal. http://www.c3.lanl.gov/~rocha/bioinformatics/

SCIENTIFIC TRANSLATIONS:
Varela F., E. Thompson and E. Rosch [2001]. *A Mente Corpórea: Ciência Cognitiva e Experiência Humana*. Editora Piaget, Portugal. Translation and Scientific Editing by Luis M. Rocha from the original "*The Embodied Mind*".

LONG RESEARCH VISITS AND COLLABORATIONS

UNIVERSITY OF CALIFORNIA, LOS ANGELES, INSTITUTE FOR PURE AND APPLIED MATHEMATICS
Fellowship appointment, March-June 2004
Program on "Proteomics: Sequence, Structure, Function"

INSTITUTO DE SISTEMAS E ROBOTICA, INSTITUTO SUPERIOR TÉCNICO, Lisbon Portugal.
Visiting Professor, 09/00-present.
Works with graduate students and fellow faculty on evolutionary approaches to information systems.

THE SANTA FE INSTITUTE, SANTA FE, NEW MEXICO, U.S.A.
Member of Research Community, Since August 1996
Joined the SFI's research community. Visited the Institute and worked with Melanie Mitchell and others, on models of Evolutionary Systems utilizing Fuzzy Logic and Genetic Algorithms. Delivered a talk.

THE PRINCIPIA CYBERNETICA PROJECT
Associate, Since 1991
Computer-supported collaborative development of an evolutionary-systemic philosophy. This project has been at the forefront of the development hypertext technology and the World Wide Web since 1990. http://pespmc1.vub.ac.be/

FUZZY SETS AND SYSTEMS GROUP, DEPARTMENT OF COMPUTER SCIENCE AND APPLIED MATHEMATICS, UNIVERSITY OF GHENT, BELGIUM
Visiting Researcher, Summer 1993
Worked with Etienne Kerre and Bernard de Baets.

SHORT DEGREES

LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL (NATIONAL LABORATORY FOR CIVIL ENGINEERING), LISBON, PORTUGAL
4-month intensive post-graduate course (6 hours daily) on Digital Control Systems, 1991.

INSTITUTO SUPERIOR TÉCNICO, LISBON, PORTUGAL
3-month intensive (6 hours daily) summer course, sponsored by the Social European Fund, on Computer Control of Noise Pollution, 1988.

TECHNICAL SKILLS

PROGRAMMING LANGUAGES AND PROTOCOLS: Delphi, Pascal, C^{++}, Java, Perl, Fortran, LISP, Basic**,** HTML, VRML, CGI, JavaScript, Active X, XML, DHTML, CSS.
SOFTWARE: Several tools in *Informatics, Computational Biology, Soft Computing, Simulation, Mathematics and Statistics***.**
LANGUAGES: Portuguese (Native Language), English (Fluent), French, Spanish, Japanese.

APPENDIX A - COURSE LIST FOR THE LICENTIATE DEGREE IN MECHANICAL ENGINEERING AT THE INSTITUTO SUPERIOR TECNICO, LISBON, PORTUGAL

The courses on the following list were semester-length courses taken over the period of 5 years. 5 courses were taken each semester, 10 each year. Portions of the final year, were completed in England in the Staffordshire University.

FALL 1985
- *General Chemistry*
- *Machine Drawing I*
- *Computer Science*
- *Linear Algebra*
- *Mathematical Analysis I*

SPRING 1986
- *Mathematical Analysis II*
- *Introduction to Numerical Analysis*
- *Machine Drawing II*
- *Materials I*
- *General Mechanics*

FALL 1986
- *Mathematical Analysis III*
- *Probability and Statistics*
- *Electromagnetism*
- *Applied Mechanics I*
- *Materials II*

SPRING 1987
- *Mathematical Analysis IV*
- *General Thermodynamics*
- *Introduction to Electrical Engines*
- *Applied Mechanics II*
- *Material Mechanics I*

FALL 1987
- *Applied Mathematics to Mechanical Engineering*
- *Thermodynamics I*
- *Fluid Mechanics I*
- *Solid Mechanics*
- *Material Mechanics II*

SPRING 1988
- *Fluid Mechanics II*
- *Electronics and Instruments*
- *Machine Design I*
- *Mechanical Technology I*
- *Thermodynamics II*

FALL 1988
- *Applied Numerical Analysis to Mechanical Engineering: Finite Elements*
- *Machine Design II*
- *Heat Transfer*
- *Control Systems*
- *Mechanical Technology II*

SPRING 1989
- *Instruments*
- *Advanced Mathematics: Complex Analysis*
- *Economics*
- *Data Structures*
- *Industrial Automation*

FALL 1989
- *Variational Mechanics*
- *Robotics*
- *Financial Analysis*
- *Systems Identification*
- *Introduction to Cybernetics*

SPRING 1990
- *Digital Control*
- *Manufacturing Management*
- *Operations Research*
- *Systems Project: Fuzzy Relational Databases and Conversation Theory*
- *Thermic Engines*

APPENDIX B: PERIOD AT THE STAFFORDISHIRE UNIVERSITY, STAFFORD, ENGLAND

The courses taken at this institution, in the Masters Program in Industrial Engineering, were in the areas of communication protocols, simulation of manufacturing systems (using the software SIMAN), digital control, numerical control, robotics, etc. My research project consisted of building the control system for a Flexible Manufacturing Cell which contained numerically controlled machines, as well as robotic arms used to grab parts from an electrical conveyor. The control system was programmed in *C* and loaded on a IBM PC which communicated with all the cell's components as well as a couple of Programmed Logic Controllers. Research was sponsored by the European Union exchange program ERASMUS.